May 1951 E-820

United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

TESTS WITH BENZENE HEXACHLORIDE FOR THE CONTROL OF INSECTS ATTACKING PEANUTS, 1946-1949

By F. W. Poos and T. N. Dobbins, Division of Cereal and Forage Insect Investigations, and E. T. Batten and G. M. Boush, Virginia Agricultural Experiment Station

The direct application of either technical benzene hexachloride or lindane to soil in which peanuts are to be planted immediately or in which peanuts are growing is not recommended. However, in view of the widespread concern about the flavor of peanuts grown in soil containing residues of these insecticides, the results of experiments conducted with them for the control of insects attacking peanuts at Beltsville, Md., and in southeastern Virginia during 1946 to 1949 are presented herein. Results of previous experiments were reported by Poos et al. (3), by Dobbins and Fronk (1), and by Fronk and Dobbins (2).

DDT had been found effective against the tobacco thrips (Frankliniella fusca (Hinds)) on seedling peanuts and against the potato leafhopper (Empoasca fabae (Harr.)) on the peanut foliage, but at least 65 pounds per acre were found necessary in the soil to control the southern corn rootworm (Diabrotica undecimpunctata howardi Barber). Experiments comparing benzene hexachloride with DDT were therefore undertaken.

Tests in 1946

Benzene hexachloride[1/] was first applied to peanut foliage for control of the tobacco thrips in 1946 at Beltsville, Md., and Holland, Va. (Poos et al. 3). At Beltsville an emulsion of benzene hexachloride was applied as a spray to seedling peanuts on June 24 and July 3 and 9. The emulsion was prepared by adding 1-1/3 ounces of a 50-percent emulsifiable concentrate (gamma isomer 10 percent) to 1 gallon of water. The control of thrips on the treated plots was good, and the increase in yield was as

---

1/ References to benzene hexachloride in this paper indicate the technical material, although concentrations and dosages are given in terms of the gamma isomer.

great as that on plots treated with a 4-percent DDT emulsion. An insecticide residue[2/] equivalent to 13.4 p.p.m. of organic chlorine in excess of that found on untreated foliage was reported on the samples collected on October 8 from the five plots treated with benzene hexachloride. However, a 2-percent DDT dust was applied to these plots on July 30 and August 8 to control the potato leafhopper, and the DDT could account for some of the organic chlorine.

At Holland benzene hexachloride dust containing 1 percent of the gamma isomer was applied with hand equipment to small plots of seedling peanuts on May 24 and June 5 and 18, to determine the effectiveness of this insecticide against the tobacco thrips. Control was definitely better than that obtained with a 2-percent DDT dust applied to comparable plots. Neither of these dusts was so effective as a spray containing 4 percent of DDT. No insecticide residues were present on any of the samples of hay collected from these plots in November.

Tests in 1947

Applications to the soil.--Benzene hexachloride dust was first applied to soil for the control of the southern corn rootworm and other coleopterous larvae at Holland in 1947 (Dobbins and Fronk 1). Two dosages were used on two comparable series of 1-square-rod plots. There were four replications of each treatment in each series. The first series of plots was treated on June 24 and the second on July 14. Four pounds of dust containing the desired strength of active ingredient were applied to each plot. The dusts were broadcast by hand as uniformly as feasible and worked into the upper 1 to 2 inches of soil with a garden rake. Estimates of larval injury to pods were made on September 9. A minimum of 100 pods from each plot was examined, and the results are summarized in table 1. Benzene hexachloride applied to the soil on June 24 or July 14 at dosages of 0.5 or 1 pound of the gamma isomer per acre significantly controlled the southern corn rootworm.

2/ The Division of Insecticide Investigations of this Bureau made all the chemical analyses mentioned in this report, unless otherwise noted. Determinations of organic chlorine were made by the procedures recommended by the Association of Official Agricultural Chemists in their Methods of Analysis 1950, pp. 367-424. Corrections were made for comparable determinations in untreated materials. Amounts of 1 p.p.m. and less are of doubtful accuracy. The organic-chlorine content was converted to benzene hexachloride by multiplication by the factor 1.36.

Table 1.--Injury to peanut pods by coleopterous larvae following applications of benzene hexachloride dust to the soil. Holland, Va., 1947

Treatment	Gamma isomer per acre	Pods injured			
		Treated on June 24		Treated on July 14	
		By southern corn root-worm	By other larvae	By southern corn root-worm	By other larvae
	Pounds	Percent	Percent	Percent	Percent
Benzene hexachloride	0.5	16	0.6	13	3.5
	1	9	.4	12	2.1
Untreated	-	49	.6	38	3.3
Difference required for significance at 5% level	-	15.3	-	15.7	-

Personnel at the Tidewater Field Station of the Virginia Agricultural Experiment Station and several visitors tasted the raw peanuts grown on these plots and detected no off-flavor.

Applications to the foliage.--An emulsion of benzene hexachloride containing 0.1 percent of the gamma isomer (prepared from a commercial 10-percent emulsifiable concentrate, and an impregnated dust containing 1 percent of the gamma isomer were applied to small plots of seedling peanuts at Beltsville in 1947 for the control of the tobacco thrips.

The plots were sprayed on June 12, 18, 20, and 30 with a knapsack sprayer having a conventional disk-type nozzle. A heavy rain fell immediately after the spraying on June 18, which was therefore repeated on June 20. Observations on July 1 showed that 87 percent of the leaves on the plants treated with benzene hexachloride were uninjured as compared with 94 percent uninjured on plants treated similarly with a 4-percent DDT emulsion.

In the plots treated with the impregnated benzene hexachloride dust by means of a rotary hand duster 72 percent of the leaves were uninjured as compared with 69 percent in the plots treated with a 2-percent DDT dust. Observations made early in October to determine the effect of the dust applications on the injury to pods by coleopterous larvae indicated no consistent differences between dusted and untreated plots.

Pods from three plants selected at random from each of the five sprayed plots were examined on October 3 to determine the percentage showing insect injury. The reduction in pod injury resulting from the

benzene hexachloride spray was highly significant. In the treated plots only 6 percent of the pods were injured by the southern corn rootworm and 4 percent by other coleopterous larvae, whereas, in the untreated plots 29 percent were injured by the rootworm and 10 percent by other larvae.

Samples of forage were taken on September 30 from the variously treated plots, air-dried, and analyzed for organic chlorine. From these analyses the following values were computed.

	P.p.m.
Benzene hexachloride:	
Emulsion	None
Dust	4.9
DDT:	
Emulsion	3
Dust	2.2

A benzene hexachloride dust containing 1 percent of the gamma isomer was applied to seedling peanuts for control of the tobacco thrips at Holland on May 23 and June 6 and 24. On June 24 a count of the leaves and injured leaflets on 60 randomly selected plants in each plot showed 78 percent control as compared with only 16 percent obtained with the 2-percent DDT dust. No organic chlorine was found by chemical analyses of samples of forage taken from these plots in November just before the crop was picked.

Tests in 1948

Applications to the foliage.--At Holland, from June 19 to August 23, 1948, seven applications of several insecticides, including benzene hexachloride in dusts containing 1 or 2 percent and in emulsions containing 0.5 percent of the gamma isomer, were applied to the foliage with hand equipment to control the southern corn rootworm (Fronk and Dobbins 2). The results, given in table 2, indicate that good control of this insect in peanuts can be obtained with frequent applications to the foliage. Benzene hexachloride gave significantly better control than any of the other insecticides.

No increased amounts of organic chlorine over those in untreated samples were found by chemical analysis of foliage samples taken separately from the dusted and sprayed plots on October 18. Samples of shelled peanuts harvested separately from these plots on October 20 were reported to contain less than 1 p.p.m., if any, of benzene hexachloride.

Table 2.--Infestation and yield of field-cured peanuts from plots in which the foliage was treated seven times with benzene hexachloride to control the southern corn rootworm. Holland, Va., 1948

Treatment	Approximate total gamma isomer per acre	Infested pods	Yield per acre
	Pounds	Percent	Pounds
Dusts			
Untreated check	-	71	1,955
Benzene hexachloride, gamma isomer			
1 percent	1.05	10	2,526
2 percent	1.82	7	2,250
Difference required for significance at 5-percent level	-	9	--
Emulsions			
Untreated check	-	78	1,955
Benzene hexachloride, gamma isomer			
0.5 percent	0.049	25	2,576
Difference required for significance at 5-percent level	-	6	--

At Beltsville benzene hexachloride was applied on June 25 and July 2 and 12 to the foliage on small plots of peanuts in comparison with DDT to control the tobacco thrips. Plots were also examined for injury by coleopterous larvae. In one test five plots were treated with an emulsion containing 0.5 percent of the gamma isomer and five plots with a 2-percent DDT emulsion. In another test six plots were treated with a dust containing 1 percent of the gamma isomer and six plots with a sulfur dust impregnated with 1 percent of DDT. The results of these tests, given in table 3, indicate that in spray form benzene hexachloride was approximately as effective as DDT against the tobacco thrips; and in dust form it was more effective than DDT. All the plots in these experiments were treated on July 26 and August 2 and 13 with a 1-percent impregnated DDT-sulfur dust, but the plots treated earlier with benzene hexachloride had fewer pods injured by coleopterous larvae than those treated with DDT.

Table 3.--Effect of three applications of benzene hexachloride or DDT to peanut foliage on the injury by the tobacco thrips and coleopterous larvae. Beltsville, Md., 1948

Treatment	Approximate total active ingredient per acre	Tobacco thrips		Pods injured by coleopterous larvae
		Average injured leaflets per leaf[1/]	Control	
	Pounds	Number	Percent	Percent
Emulsions				
Untreated check	-	1.25	-	66
Benzene hexachloride, gamma isomer 0.5 percent	1.1	.26	79	25
DDT 2 percent	4.6	.21	84	53
Difference required for significance:				
At 5-percent level	-	.11	-	20
At 1-percent level	-	.15	-	27
Dusts				
Untreated check	-	1.15	-	44
Benzene hexachloride, gamma isomer 1 percent	0.7	.17	86	4
DDT 1 percent, in sulfur	.7 (DDT)	.44	62	45
Difference required for significance:				
At 5-percent level	-	.16	-	17
At 1-percent level	-	.22	-	23

1/ Each peanut leaf has 4 leaflets.

Application to the soil.--At Holland tests with DDT and benzene hexachloride were conducted on plots of Virginia Jumbo peanuts planted on May 24, 1948. Each plot contained 6 rows and was 1 square rod in area. Each treatment was replicated five times in a Latin square. Applications were made on June 3 in one series and on July 7 in the other by the same method that was used in conducting similar tests during 1947. The results are given in table 4.

The June applications were more effective than the July applications. All treatments significantly reduced the amount of pod injury caused by the southern corn rootworm, and the June 3 treatments also gave considerable control of the tobacco thrips.

Table 4. --Injury to peanut pods by larvae of the southern corn rootworm and control of tobacco thrips following applications of benzene hexachloride and DDT dusts to the soil. Holland, Va., 1948

Treatment	Gamma isomer per acre	Pods affected by rootworms				Tobacco thrips control June 24
		Injured		Penetrated		
		Treated June 3	Treated July 7	Treated June 3	Treated July 7	
	Pounds	Percent	Percent	Percent	Percent	Percent
Untreated checks	-	86	84	78	68	-
Benzene hexachloride	0.5	25	36	16	25	47
	1	8	28	4	20	60
	1.5	7	21	3	13	63
DDT[1/]	-	18	42	10	29	84
Difference required for significance:						
At 5-percent level	-	9	14	-	-	-
At 1-percent level	-	13	20	-	-	-

1/ 67 pounds per acre applied on June 3 and 100 pounds on July 7.

To determine the yield, in October the plants in the two inside rows of each plot were dug, bundled, and artifically dried, and the peanuts were picked with a mechanical picker and weighed. There were significant increases in yield on plots treated with benzene hexachloride at 1 and 1.5 pounds of the gamma isomer applied on June 3 and from all the July treatments. Chemical analyses of several samples of field-cured peanuts (in the shell) from the plots in which benzene hexachloride had been used gave somewhat erratic results. Twelve additional samples of shelled peanuts from these plots were reported to have a benzene hexachloride content of less than 1 p.p.m., if any. No off-flavor was detectable in the unprocessed nuts or, in preliminary tests, in roasted nuts.

Tests in 1949

Applications to the foliage. --In 1949 a suspension spray containing 1 percent of lindane was applied to five small plots of seedling peanuts at Beltsville on June 15 and 22 for control of the tobacco thrips, and additional applications were made on July 7, 28, and August 17 for control of the southern corn rootworm. From June 29 to July 1 highly

significant (83 percent) control of the injury caused by the tobacco thrips was found by counting leaves and injured leaflets. The early-season growth of the treated plants was much greater than that of the untreated checks. Differences in plant growth could be detected up to the middle of August.

These plots were examined on October 4-9 for injury to pegs and pods by the southern corn rootworm. The lindane treatment gave 90 percent control over the untreated check. Three samples of forage collected from the lindane-treated plots on October 10 and air-dried showed an average organic-chlorine content of 12 p.p.m. more than the untreated check. These five plots had been treated on August 15 with a sulfur dust impregnated with 1 percent of DDT for the control of the potato leafhopper, and the DDT could account for some of the organic chlorine.

At Holland nine insecticide formulations were applied with hand equipment on June 15 and July 6 and 27, and August 18 to peanut foliage on small plots each 2 rods long by 1 rod wide for control of the southern corn rootworm. The plots were examined for rootworm injury to pegs and pods on October 11 and, as in previous tests, the control obtained with benzene hexachloride was highly significant. Infestations were recorded as follows: Untreated plots 62 percent, plots treated with benzene hexachloride dust (gamma isomer 2 percent) 5 percent, and plots treated with benzene hexachloride emulsion sprays (gamma isomer 1 percent) 6 percent. A composite sample of the hay taken from these plots on October 5, air-dried, and analyzed was reported to contain a benzene hexachloride residue of 3 p.p.m. for the dust and 22 p.p.m. for the emulsion. The variation in the weights of mature nuts obtained from one 33-foot row in each plot appeared to be associated with the treatment, although the increases in yield were not significant at the 5-percent level. Data from these plots indicated that the proportion of sound meats was highly significantly greater in the treated plots than in the untreated plots.

Applications to the soil. --At Holland two series of identically arranged 1-square-rod plots were given similar soil treatments with lindane and benzene hexachloride, one series on June 6 and the other on June 23. Each treatment was replicated four times. In order to obtain maximum rootworm infestation the plots were located in an area of the field that normally was poorly drained. However, because of unusually heavy precipitation (36.29 inches) from June through September the plots were flooded to such an extent that infestation by the southern corn rootworm was markedly below normal and no significant differences were recorded between treated and untreated plots in either series. The excessive rainfall may have caused greater-than-normal absorption of benzene hexachloride by the nut meats. Composite samples of shelled peanuts

collected on October 20 from two plants from each plot were analyzed for organic-chlorine content. The results calculated to benzene hexachloride are shown in table 5.

Table 5.--Benzene hexachloride residues reported in samples of shelled peanuts grown in soil treated with lindane or benzene hexachloride. Holland, Va., 1949

Treatment	Date applied June 1949	Gamma isomer per acre	Benzene hexachloride content
		Pounds	P.p.m.
Lindane	6	0.5	4.5
		1	.2
		1.5	.8
	23	.5	0
		1	0
		1.5	1.8
Benzene hexachloride	6	1	1.9
	23	.5	1.9
		1	1.8

Tests with soil treatments on plots each 16 rows wide and about 950 feet long were also conducted at Holland in 1949. Unreplicated treatments with lindane and benzene hexachloride dusts were applied with a 2-row fertilizer distributor, such as is commonly used on peanuts in this area. The dusts were immediately plowed into the upper 2 to 3 inches of soil. Estimates of rootworm injury to nuts and pegs were made at various intervals from August 11 to October 3. The differences in injury between the treated and untreated plots were highly significant, but there were no significant differences among the various treatments. This was true of the injury caused by the tobacco thrips from data recorded on June 24, as well as that caused by the southern corn rootworm. A summary of the results is given in table 6.

Three areas in each of the seven plots were harvested separately and the field-cured nuts were weighed. Each of these areas consisted of the eight middle rows 100 feet long, or about 1/5 acre. Because excessive rainfall delayed digging and caused many of the nuts to come off in the soil, the yields recorded from two of the areas in each plot were obviously not comparable. The other area of each plot, harvested separately, was on higher ground and provided more comparable yields;

the increases of field-cured nuts from the treated plots ranged from 16 to 45 percent. Three samples of shelled peanuts from each plot were analyzed for organic-chlorine content and were reported to average from 2 to 8 p.p.m. (table 6) of benzene hexachloride.

Table 6.--Effect of benzene hexachloride and lindane dusts applied to the soil on infestation by the tobacco thrips and the southern corn rootworm and the benzene hexachloride residue in shelled nuts. Holland, Va., 1949

Plot	Dusts and pounds per acre	Tobacco thrips control	Rootworm injury		Benzene hexachloride in shelled nuts
			Average	Range	
		Percent	Percent	Percent	P.p.m.
	Fertilizer separate				
1	Lindane, 1	91	2	0.7- 6	2
2	Untreated	-	34	11 -73	-
3	Lindane, 0.75	78	5	2 -12	4
	In fertilizer				
4	Lindane, 1.25	90	3	1 - 4	3
5	Benzene hexachloride gamma isomer, 1	80	4	0 - 7	8
6	Lindane, 1	80	3	.3- 7	8
7	Untreated	-	38	17 -66	-
Difference required for significance:					
	At 5-percent level	-	12.6	-	-
	At 1-percent level	-	16.8	-	-

Several peanut growers in Virginia applied benzene hexachloride in fertilizer to small areas of from 0.42 to 1.38 acres for control of the southern corn rootworm in 1949. On only four farms was it possible to obtain what appeared to be reasonably reliable comparisons of yields between treated and untreated areas. The results are given in table 7. Two growers applied sufficient benzene hexachloride to give 1 pound of the gamma isomer mixed with 499 pounds of 0-12-12 fertilizer per acre, and the other two, 400 pounds of the fertilizer with sufficient benzene hexachloride to give 0.8 pound of the gamma isomer. Infestation counts indicated that adequate control of the rootworm was obtained with either dosage. However, the yield of peanuts was not always increased. The treated peanuts matured earlier than the untreated ones, and the delay in digging the treated peanuts caused many of them to be left in the soil.

Table 7.--Tests on various types of soil with benzene hexachloride for control of the southern corn rootworm on peanuts in southeastern Virginia. 1949

Soil type	Variety of peanut	Pegs and pods infested		Yield per acre			Increase in sound meat over untreated	Benzene hexachloride residue in shelled nuts
		Treated	Untreated	Treated	Untreated	Increase over untreated		
		Percent	Percent	Pounds	Pounds	Percent	Percent	P.p.m.
Craven fine sandy loam	Virginia Jumbo	2.7	36	1,718	1,608	7	7	3
Onslow loamy fine sand	Atkins Runner	2.3	51	986	997	-	6	-
Moyock fine sandy loam	Virginia Branch	.5	35	2,530	2,393	6	6	7
Kempsville fine sandy loam	Atkins Runner	.7	60	2,673	2,151	24	5	0

Tests on Flavor and Acceptability

Samples of the field-cured peanuts harvested from the plots indicated in table 6, as well as other samples taken from outlying areas that had been treated with benzene hexachloride by farmers in 1949, were submitted to a number of agencies for tests of various kinds. The available results of these tests are briefly reported here.

Tests made by the Bureau of Plant Industry, Soils, and Agricultural Engineering.--At Beltsville, J. H. Beattie roasted peanuts and made peanut butter from samples of peanuts from each of the seven plots denoted in table 6. He reported objectionable off-flavor in peanuts from plot 5 only, which had been treated with benzene hexachloride. Mr. Beattie kindly furnished the authors samples of the roasted peanuts and the peanut butter he prepared from plots 1, 5, and 7. When these samples were submitted to various amateur tasters, 13 out of 14 reported the peanut butter made from peanuts from plot 5 to be objectionable and 14 of 23 reported off-flavor in the roasted peanuts from this plot. Only two of these tasters reported slight off-flavor in plot 1 (lindane treated), one in the roasted peanuts and one in the peanut butter.

Tests made at Cornell University.--Samples of two lots of peanuts that had been grown in Moyock fine sandy loam soil in Isle of Wight County, Va., were sent to W. A. Rawlins, at Cornell University, for taste tests. He reported that 85 percent of the judges noted off-flavor in the peanuts grown in the soil treated with benzene hexachloride at 1 pound of the gamma isomer per acre. All these judges considered the flavor of the treated peanuts less desirable than that of the untreated peanuts. This was chiefly a test of preference and the judges were not asked to comment on palatability.

Tests made by peanut-processing companies.--Samples from the plots indicated in table 6 were also tested for flavor by the Planters Nut and Chocolate Company, Suffolk, Va. The nut meats were cooked in peanut oil. Peanuts from plots 1, 4, and 6 were reported to be slightly off-flavor. One sample of peanuts that had been artifically dried on the vines immediately after being dug was also reported slightly off. Among six other samples tested by this company, which were taken from areas that had been treated with benzene hexachloride by farmers, a "strong earth flavor" was reported in one sample and a slight off-flavor in two. Of 10 untreated samples of peanuts submitted, only the one artifically dried was reported off-flavor. All the samples submitted were identified by number only before being tested.

Samples of seven lots of peanuts identified by number only were submitted to Lummis & Company at Suffolk for testing. Three of the lots were grown in untreated soil and four in soil treated with benzene hexachloride or lindane. These tests were made on peanuts roasted in the shell and roasted shelled, and peanut butter. A slight to strong chemical flavor was reported in all but one sample, which was untreated and reported "roasted too high, no off-flavor noted." Obviously factors other than benzene hexachloride may cause off-flavor in peanuts.

Samples of shelled peanuts from plots 5, 6, and 7 (table 6) were also submitted to the Miner Laboratories, Chicago, Ill., through the Miller Peanut Company, Albany, Ga. They reported that no off-flavor or off-odor was clearly detected in the raw nuts, although slight differences in odor were reported by several judges. Portions of the samples were cooked in oil at 290°-325° F. for 15 minutes. In both blanched and unblanched nuts a decided musty flavor was detected by 10 judges in the nuts from plot 5 that had been treated with benzene hexachloride. Similar off-flavor in unblanched peanuts from plot 6 treated with lindane was detected by 4 judges, and in blanched peanuts by 6 judges. The report states that apparently all judges are not equally sensitive to off-flavor caused by benzene hexachloride in peanuts, and that the skins on peanuts may sometimes obscure the off-flavor. A few tests suggested that, if the off-flavor caused by benzene hexachloride in peanuts is not too strong, it may not be detected when eaten simultaneously with peanuts having no off-flavor.

Tests made by the Bureau of Human Nutrition and Home Economics. -- Palatability tests were made on 10-pound samples of shelled peanuts grown on plots 2, 5, and 6 (table 6), and the quality of the peanut oil from peanuts grown on the same plots was evaluated in cooking and palatability tests. The tests on the peanuts were conducted by Gladys L. Gilpin and Nancy Smalley, and their results are shown in table 8.

The peanuts grown in soil treated with benzene hexachloride and lindane were comparable in flavor, but both were scored slightly lower than the sample from untreated soil. Off-flavor was observed in the treated samples, whether the peanuts were judged unroasted, oven-roasted, or oven-roasted and salted. Several judges considered the off-flavor in the unroasted treated samples to be moderately strong and two found it to be very strong. Off-flavor for the two treated samples were similar when judged unroasted. Oven-roasted peanuts grown in soil treated with benzene hexachloride had a moderately strong off-flavor, whereas those from lindane-treated soil had a slightly strong off-flavor. Moderately strong off-flavor was also observed in samples prepared by roasting and salting. The difference in quality was more noticeable in the roasted and the roasted and salted nuts than in unroasted nuts.

Table 8. --Palatability scores[1/] for peanuts grown in untreated soil, and in soil treated with benzene hexachloride or lindane (plots 2, 5, and 6 in table 6). Highest possible score is 5.

Preparation of peanuts	Treatment	Natural flavor	Absence of off-flavor	General acceptability
Unroasted	Untreated	3.4	3.2	3.2
	Benzene hexachloride	3.2	2.7	2.8
	Lindane	3.2	2.8	2.7
Oven-roasted	Untreated	3.6	3.7	3.5
	Benzene hexachloride	3.1	2.2	2.3
	Lindane	3.3	3.0	2.9
Oven-roasted and salted	Untreated	3.5	3.8	3.5
	Benzene hexachloride	3.0	2.3	2.4
	Lindane	2.9	2.6	2.6

1/ Average of 3 replicates rated by 6 judges.

On the basis of these palatability scores, peanuts had stronger off-flavor and lower acceptability scores when grown in soil treated with benzene hexachloride or lindane than when grown in untreated soil.

The quality of the oil made from peanuts grown on the same plots was evaluated in cooking and palatability tests by Elsie H. Dawson and Patricia Trimble. The Planters Nut and Chocolate Company supplied 2-quart samples of cold-pressed peanut oil (refined-washed-dried) from peanuts grown on each plot, to be used for french-frying Florida Long White new potatoes. The palatability of the potatoes cooked simultaneously in the three lots of peanut oil was evaluated by a panel of six judges. Tests with the same oil were conducted on three consecutive days, enough fresh oil being added to make up the required quantity. Two of the judges noted a musty flavor in the initial batch of potatoes cooked in oil from peanuts grown in soil treated with benzene hexachloride, but this off-flavor was not noted in two successive batches of potatoes fried in the same oil. It is possible that any off-flavor can be removed by frying a single batch of potatoes in the oil. There was no appreciable difference between average acceptability scores for three batches of potatoes french-fried in the same oil, whether the oil was from peanuts grown in untreated soil, in soil treated with lindane, or with benzene hexachloride.

SUMMARY

Benzene hexachloride, first applied to foliage of peanuts for control of the tobacco thrips (Frankliniella fusca (Hinds)) at Beltsville, Md., and Holland, Va., in 1946, compared favorably with DDT in effectiveness against this insect. Emulsion sprays containing 0.1 to 1 percent and dusts containing 1 or 2 percent of the gamma isomer applied to peanut foliage on small plots from 1947 through 1949 gave significant control of the southern corn rootworm (Diabrotica undecimpunctata howardi Barber) and the tobacco thrips. In most tests no insecticide residue was reported on samples of foliage taken from the plots at harvest time, and all samples of shelled peanuts harvested separately from the dusted and sprayed plots in 1948 were reported to contain less than 1 p.p.m., if any, of benzene hexachloride.

Benzene hexachloride, first applied as dusts to the soil on small plots at Holland in 1947 for control of injury to peanut pods by coleopterous larvae, gave best results at the rate of 1 pound of the gamma isomer per acre in June. Applications of dusts and emulsion sprays on small plots in 1948 confirmed these results and gave control not only of the southern corn rootworm but also of the tobacco thrips. All applications made in June were more effective than those made in July. No off-flavor was detectable in the unprocessed nuts tested during 1947 and 1948. In preliminary tests no off-flavor was detected in the roasted nuts grown in soil treated with benzene hexachloride.

Field tests with benzene hexachloride and lindane in 1949 indicated that applications to the soil of 0.8 to 1 pound of the gamma isomer per acre, either with fertilizer or separately, gave significant control of the southern corn rootworm and the tobacco thrips on peanuts. Yields of field-cured peanuts were increased, and the proportion of sound meats was highly significantly greater in the treated plots than in the untreated plots. Chemical analyses indicated benzene hexachloride contents ranging from 0 to 7 p.p.m. in samples of shelled peanuts from plots receiving these treatments.

Taste tests indicated off-flavor in the peanuts grown in treated soil; also that off-flavor may be caused by other factors. Amateur judges noted off-flavor caused by lindane less frequently than that caused by benzene hexachloride. There was little difference in the quality of oils made from peanuts grown on plots treated with these insecticides when judged by the quality of potatoes french-fried in these oils.

In view of the off-flavor found in peanuts grown in soil treated with benzene hexachloride or lindane, the application of these insecticides to soil in which peanuts are to be planted immediately or in which peanuts are growing, is not recommended.

LITERATURE CITED

(1) Dobbins, T. N., and Fronk, W. D.
1948. Insecticide tests for the control of coleopterous larvae attacking peanuts in the soil. Jour. Econ. Ent. 41: 815-816.

(2) Fronk, W. D., and Dobbins, T. N.
1949. Insecticide tests for control of the southern corn rootworm in peanuts. U.S. Bur. Ent. and Plant Quar. E-782, 10 pp. [Processed.]

(3) Poos, F. W., Grayson, J. M., and Batten, E. T.
1947. Insecticides to control tobacco thrips and potato leafhopper on peanuts. Jour. Econ. Ent. 40: 900-905.